Task 2

Project Title: Watering Station Best Management Practices (BMP) Effectiveness

Sponsoring Agency: FDACS Office of Agricultural Water Policy

Project No. 124329

Investigating Agency: University of Florida (UF), Institute of Food and Agricultural Sciences (IFAS)

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Background

Pursuant to the Florida Watershed Restoration Act (FWRA), section 403.067(7)(c)3, F.S., the Florida Department of Agriculture and Consumer Services (FDACS), Office of Agricultural Water Policy (OAWP), develops, adopts, and assists with the implementation of agricultural Best Management Practices (BMPs) to protect and conserve water resources. Funding for BMP projects that complement the OAWP's mission is consistent with FWRA objectives. In this regard the University of Florida's, Institute of Food and Agricultural Sciences (UF/IFAS) continues to play an important role in assisting the nursery industry with implementing BMPs. This BMP project extends existing surface water quality monitoring at two locations to demonstrate the effectiveness of mitigating runoff from container watering stations.

Description of Task

Task 2 Deliverable: Final report with results from sample collections at both sites, analyzed for NO_3-N, TKN, and TP.

Site 1: Gadsden County - Wall installed (Feb. 2015) in ditch that conveys runoff from watering station.

Work Performed

Shower runoff water and runoff water in conveyance ditch above and below wall of boards stacked on edges were sampled on Oct.7, Nov. 23, and Dec. 14, 2015 and were sampled on Jan. 19, Feb. 15 and March 14, 2016. Three samples were collected at each of the six times from each of five locations: runoff from shower at spillway (SPR), runoff in ditch directly below the concrete spillway (BCS), runoff at the wall upstream (AWU), runoff at the wall downstream (AWD), and water in a collection basin (BAS). Samples were usually collected from first four locations about midday after one wagon of plants passed 5-11 times under the shower. Additional wagons continued to pass under the shower and samples from the basin (BAS) were collected about four hours later. The basin (approximately 16 ft wide x 47 ft long x 3 ft deep) was added in September of 2015. The dam of basin is approximately 200 feet downstream from the wall.

In addition to the sampling described above, three samples were obtained from shower water (SOW) applied to plants and three samples were collected from BCS, AWD, and BAS prior to shower use the day of sampling. Sampling on Nov. 23 and later was done on Monday so any water in the ditch prior to shower use was probably residual from the previous week or from rain.

Total Kjeldahl nitrogen (TKN), nitrate nitrogen (NO_3-N), and total phosphorus (TP) concentrations of samples were determined according to procedures of the Environmental Water Quality Laboratory at University of Florida. Average concentrations for each sampling time and location are given in Table 1.

For samples collected after the shower ran or wagon passed under shower, the overall average NO_3-N, concentrations AWD (6.89 mg/L) did not change much compared to AWU (5.73 mg/L). This indicates the wall had minimal effect on NO_3-N. Hence, a basin was installed downstream from the wall where the residence time for NO_3-N could be increased hoping to achieve denitrification. TP exhibited a similar response of little change AWU (626.4 mg/L) compared to AWD (628.4 mg/L).

For samples collected in the basin approximately four hours after samples collected for AWD, overall average concentrations of NO_3-N in the basin were lower (2.51 mg/L) than AWD (6.89 mg/L). TKN and TP were similar regardless of sampling AWD or in the basin. Additionally, NO_3-N, TKN, and TP concentrations in BAS at beginning of day prior to any runoff generated from the shower were similar to BAS concentrations approximately four hours after sampling shower runoff. Concentrations of NO_3-N, TKN, and TP AWD tended to be slightly more after the shower ran generating runoff than before shower ran.

It appears the wall has minimal impact on runoff NO3-N and TP concentrations; however, the wall is retaining sediment that contains organic nitrogen as verified by the lower TKN concentration AWD (1.34 mg/L) compared with the TKN concentration AWU (4.53 mg/L). Sediment has accumulated approximately 18 inches deep in front of the wall since the wall was constructed in Feb. 2015.

Diverting runoff to a basin would be useful if the runoff was reused for irrigation so the basin did not overflow. In some locations, land is limited and large basins are not a viable option. An alternative approach is to clean the runoff or pass runoff through absorbing agents. The researcher is currently discussing this possibility with a company that produces a P-absorbing agent mixed with carbon sources for nitrogen denitrification. Modules of these materials could be used to filter or clean runoff water and the nutrient laden materials that resulted from the cleaning process could subsequently be used for potting substrate.

Table 1. Average NO_3-N, TKN, and TP concentrations of samples collected before or after watering station shower operation.

		Before Shower Ran			After Shower Ran					
Sample date	**NO_3-N (mg/L)**	**BCS**	**AWD**	**BAS**	**SPR**	**BCS**	**AWU**	**AWD**	**BAS**	**SOW**
7-Oct		0.26	0.03	*	0.14	0.21	0.56	0.66	0.25	0.05
23-Nov		48.04	22.62	2.45	4.78	15.17	12.94	22.09	2.39	0.02
14-Dec		3.21	0.81	2.36	0.22	0.91	0.85	2.24	2.34	0.06
19-Jan		15.82	4.08	1.72	0.40	9.97	12.08	8.11	3.05	0.18
15-Feb		1.67	0.11	1.91	0.57	0.88	0.97	2.49	1.13	0.13
14-Mar		15.04	0.16	*	0.39	5.87	6.96	5.77	5.92	0.11
Overall Avg.		**14.01**	**4.64**	**2.11**	**1.08**	**5.50**	**5.73**	**6.89**	**2.51**	**0.09**
	TKN (mg/L)	**BCS**	**AWD**	**BAS**	**SPR**	**BCS**	**AWU**	**AWD**	**BAS**	**SOW**
7-Oct		0.70	0.50	*	0.45	0.68	0.56	0.60	0.65	0.29
23-Nov		20.86	1.97	1.74	5.27	9.63	9.00	2.58	1.82	0.26
14-Dec		6.15	0.19	1.92	1.28	2.6	2.58	1.14	2.9	0.12
19-Jan		6.84	0.39	1.26	1.05	6.56	9.54	1.37	1.69	0.18
15-Feb		2.68	0.16	0.67	1.13	1.67	1.46	0.49	0.86	0.36
14-Mar		6.17	0.54	*	1.08	3.47	4.06	1.87	1.74	0.46
Overall Avg.		**7.23**	**0.63**	**1.40**	**1.71**	**4.10**	**4.53**	**1.34**	**1.61**	**0.28**
	TP (µg/L)	**BCS**	**AWD**	**BAS**	**SPR**	**BCS**	**AWU**	**AWD**	**BAS**	**SOW**
7-Oct		600.6	422.5	*	192.2	229.4	461.8	448.1	479.9	3.14
23-Nov		4088.0	1434.7	1483.0	1936.0	1752.3	1581.3	1415.3	1489.0	0.47
14-Dec		732.4	635.9	453.6	161.9	304.5	329.0	622.1	631.1	0.72
19-Jan		1060.7	518.2	516.1	205.5	690.5	957.1	530.2	524.1	1.67
15-Feb		296.2	242.8	261.1	181.1	185.7	208.0	359.5	237.4	2.25
14-Mar		332.3	233.2	*	110.8	180.5	221.0	394.9	405.6	2.48
Overall Avg.		**1185.0**	**581.2**	**678.5**	**464.6**	**557.2**	**626.4**	**628.4**	**627.9**	**1.79**

BCS=Below Concrete Slab

AWD=At Wall Downstream

BAS=Basin, *no water on Oct.7 and Mar. 14

SPR=Spillway Runoff

AWU=At Wall Upstream

SOW=Source of Water

Site 2: Sumter County - Concrete pad with collection channel was installed (Feb. 2015) under watering station shower to collect and divert runoff.

Work Performed

One wagon of 84 containers (trade size 3 gallon) was passed once under watering station shower on Oct. 27, Nov. 18, and Dec. 29, 2015 and Jan. 26, Feb. 25, and Mar. 29, 2016. The time to pass under the shower ranged from 14 to19 sec. Plants potted in the substrate on each date were Parsonii Juniper, Indian Hawthorn, Sweet Viburnum, Indian Hawthorn, Indian Hawthorn, and Sandankwa Viburnum, respectively. The potting substrate was composed of 60% pine bark, 40% compost with 18.5 pounds/cubic yard of 17-5-10 controlled-release fertilizer.

Three samples of irrigation water were collected from each shower operation. Plants drained for approximately 20 minutes while the wagon was on the concrete pad and three samples of runoff were collected each time from channel in concrete pad. Volume of water applied was metered and runoff volume in channel was measured. Total Kjeldahl nitrogen (TKN), nitrate nitrogen (NO_3-N), and total phosphorus (TP) concentrations of samples were determined according to procedures of the Environmental Water Quality Laboratory at University of Florida.

A summary of average data for all six collection times is presented in Table 2. The average amount of water applied was 160 liters (range 98-212) and the average amount of runoff collected in channel was 93 liters (range 49-136). Based on the concentration of nutrients in samples, the mg of each nutrient in shower water or in runoff in channel was determined by multiplying the nutrient concentrations for each sample by respective volumes.

The average load or amount of NO_3-N, TKN and TP was 3716, 5432, and 859 mg, respectively. These amounts include background amounts in the shower water. It is important to note this nursery injects a phosphate compound in the irrigation water to precipitate indigenous iron. The shower TP averaged 487 mg. A total of 9148 mg of nitrogen (NO_3-N+TKN) and 859 mg of TP were in the runoff. Assuming the nursery had 20 acres of trade 3 gallon containers and potted 240,000 plants like used in this evaluation; this would result in 2857 wagons passing under the shower and a load of approximately 58 pounds of nitrogen (NO_3-N+TKN) and 5 pounds of TP that could be repeated annually.

Nutrient load is impacted by the amount of water applied and by amount of runoff volume. The volume of runoff in the channel was approximately 58% of the water applied so the container substrate absorption and water residuals on wagon and concrete pad were 42% of the water applied. Nutrient concentrations in the water applied were generally less than the concentrations in runoff indicating that fertilizer contributed to nutrients in runoff. The absorption of the water by the substrate is an important way to keep nutrients from running off in large amounts as each wagon is watered. Efficient application of shower water to minimize leaching will be important to minimize nutrient loads in runoff. Future work might investigate methods to increase substrate absorption to minimize nutrient loss.

Table 2. Average NO_3-N, TKN, and TP amounts for watering station shower water and runoff in the channel.

Analytic	Shower	Shower	Channel	Channel
	mg	**liters**	**mg**	**liters**
NO3-N	65	160	3716	93
TKN	104	160	5432	93
TP	487	160	859	93

Three replicate samples were collected from shower water applied and runoff water in the channel on Oct. 27, Nov. 18, and Dec. 29, 2015 and Jan. 26, Feb. 25, 2016, and Mar. 29, 2016 after one wagon of 84, trade 3 gallon containers were filled with potting substrate and passed under shower at watering station.